B. Election/Restrictions

Applicant hereby elects the claims of Group II, namely claims 531-610, 623-625, and 665-706, drawn to a method of heating a coal formation wherein the pressure is controlled as a function of temperature or the temperature is controlled as a function of pressure, including the use of specific or exemplary pressure-temperature relationships, without traverse. Applicant reserves the right to file divisional applications capturing the subject matter of the non-elected species.

C. Election of Species

In item 5 of the Office Action, the Examiner states: "Applicant is required under 35 U.S.C. 121 to elect a single disclosed species for prosecution on the merits...." Applicant elects the species described at least in claims 570-609, drawn to a method of heating a coal formation wherein the API gravity of a produced mixture is greater than about 25° by controlling the average pressure and temperature in the formation based on an exemplary pressure/temperature relationship or formula.

In item 6 of the Office Action, the Examiner states: "Applicant is required under 35 U.S.C. 121 to elect a single disclosed species [of heater]...." Heaters are embodied at least in Figures 10-14 and 24-26. Applicant elects the species of heater described at least in claims 537, 578, 630, 672, 5154, and 5159. The generic name of the elected species is: "natural distributed combustor." Natural distributed combustors are illustrated at least in Figures 10-13.

D. Conclusion

Applicant believes that no fees are due in association with the filing of this document. If any extension of time is required, Applicant hereby requests the appropriate extension of time. If any fees are required, please charge those fees to Conley, Rose & Tayon, P.C. Deposit Account Number 50-1505/5659-09600/EBM.

Respectfully submitted,

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Date: 11/12/02

Marked-Up Version of Amendments Submitted with Amendment; Response to Office Action mailed October 10, 2002

In the Specification:

On page 53, the paragraph beginning on line 20:

As shown in FIG. 3, in addition to heat sources 100, one or more production wells ~~102~~ 104 will typically be disposed within the portion of the coal formation. Formation fluids may be produced through production well 104. ~~Production well 102 may be configured such that a mixture that may include formation fluids may be produced through the production well.~~ Production well ~~102~~ 104 may also include a heat source. In this manner, the formation fluids may be maintained at a selected temperature throughout production, thereby allowing more or all of the formation fluids to be produced as vapors. Therefore high temperature pumping of liquids from the production well may be reduced or substantially eliminated, which in turn decreases production costs. Providing heating at or through the production well tends to: (1) ~~prevent~~ inhibit condensation and/or refluxing of production fluid when such production fluid is moving in the production well proximate to the overburden, (2) increase heat input into the formation, and/or (3) increase formation permeability at or proximate the production well.

In the Claims:

531. (amended) A method of treating a coal formation in situ, comprising:

providing heat from one or more ~~heat source~~heaters to at least a portion of the formation;

allowing the heat to transfer from the one or more ~~heat source~~heaters to a ~~selected section~~part of the formation;

controlling a pressure and a temperature within at least a majority of the ~~selected section~~part of the formation, wherein the pressure is controlled as a function of temperature, or the temperature is controlled as a function of pressure; and

producing a mixture from the formation.

532. (amended) The method of claim 531, wherein the one or more ~~heat source~~heaters comprise at least two ~~heat source~~heaters, and wherein superposition of heat from at least the two ~~heat source~~heaters pyrolyzes at least some hydrocarbons within the ~~selected section~~part of the formation.

533. (amended) The method of claim 531, further comprising controlling formation conditions, wherein controlling formation conditions comprises maintaining a temperature within the ~~selected section~~part of the formation within a pyrolysis temperature range of about 270 °C to about 400 °C.

534. (amended) The method of claim 531, wherein at least one of the one or more ~~heat source~~heaters comprises an electrical ~~heaters~~.

535. (amended) The method of claim 531, wherein at least one of the one or more ~~heat source~~heaters comprises a surface ~~burners~~.

536. (amended) The method of claim 531, wherein at least one of the one or more ~~heat source~~heaters comprises a flameless distributed ~~combustors~~.

537. (amended) The method of claim 531, wherein at least one of the one or more ~~heat source~~heaters comprises a natural distributed ~~combustors~~.

538. (amended) The method of claim 531, further comprising controlling the heat such that an average heating rate of the ~~selected section~~part of the formation is less than about 1 °C per day ~~during~~ in a pyrolysis temperature range of about 270 °C to about 400 °C.

539. (amended) The method of claim 531, wherein providing heat from the one or more ~~heat source~~heaters to at least the portion of formation comprises:

heating a selected volume (*V*) of the coal formation from the one or more ~~heat source~~heaters, wherein the formation has an average heat capacity (*Cv*), and wherein the heating pyrolyzes at least some hydrocarbons within the selected volume of the formation; and

wherein heating energy/day (*Pwr*) provided to the selected volume is equal to or less than ~~*Pwr*, wherein *Pwr* is calculated by the equation:~~

~~$Pwr = h*V*C_v*\rho_{B,}$~~

~~wherein *Pwr* is the heating energy/day, *h* is an average heating rate of the formation, ρ_B~~ is formation bulk density, and wherein ~~the~~ an average heating rate (*h*) of the selected volume is ~~less than~~ about 10 °C/day.

541. (amended) The method of claim 531, wherein providing heat from the one or more ~~heat source~~heaters comprises heating the ~~selected section~~part of the formation such that a thermal conductivity of at least a portion of the ~~selected section~~part of the formation is greater than about 0.5 W/(m °C).

554. (amended) The method of claim 531, wherein the produced mixture comprises a non-condensable component, wherein the non-condensable component comprises molecular hydrogen, wherein the molecular hydrogen is greater than about 10 % by volume of the non-condensable component, and wherein the molecular hydrogen is less than about 80 % by volume of the non-condensable component at 25 °C and one atmosphere absolute pressure.

562. (amended) The method of claim 531, further comprising:

providing hydrogen (H_2) to the ~~heated section~~part of the formation to hydrogenate hydrocarbons within the ~~section~~part of the formation; and

heating a portion of the ~~section~~ part of the formation with heat from hydrogenation.

564. (amended) The method of claim 531, wherein allowing the heat to transfer comprises increasing a permeability of a majority of the ~~selected section~~part of the formation to greater than about 100 millidarcy.

565. (amended) The method of claim 531, wherein allowing the heat to transfer comprises substantially uniformly increasing a permeability of a majority of the ~~selected section~~part of the formation.

567. (amended) The method of claim 531, wherein producing the mixture comprises producing the mixture in a production well, and wherein at least about 7 ~~heat source~~heaters are disposed in the formation for each production well.

568. (amended) The method of claim 531, further comprising providing heat from three or more ~~heat source~~heaters to at least a portion of the formation, wherein three or more of the ~~heat source~~heaters are located in the formation in a unit of ~~heat source~~heaters, and wherein the unit of ~~heat source~~heaters comprises a triangular pattern.

569. (amended) The method of claim 531, further comprising providing heat from three or more ~~heat source~~heaters to at least a portion of the formation, wherein three or more of the ~~heat source~~heaters are located in the formation in a unit of ~~heat source~~heaters, wherein the unit of ~~heat source~~heaters comprises a triangular pattern, and wherein a plurality of the units are repeated over an area of the formation to form a repetitive pattern of units.

570. (amended) A method of treating a coal formation in situ, comprising:

providing heat from one or more ~~heat source~~heaters to at least a portion of the formation;

allowing the heat to transfer from the one or more ~~heat source~~heaters to a ~~selected section~~part of the formation to raise an average temperature within the ~~selected section~~part of the formation to, or above, a temperature that will pyrolyze hydrocarbons within the ~~selected section~~part of the formation;

producing a mixture from the formation; and

controlling API gravity of the produced mixture to be greater than about 25 degrees API by controlling average pressure and average temperature in the ~~selected section~~part of the formation such that the average pressure in the ~~selected section~~part of the formation is greater than the pressure (p) set forth in the following equation for an assessed average temperature (T) in the ~~selected section~~part of the formation:

$$p = e^{[-44000/T + 67]}$$

where p is measured in psia and T is measured in ~~°~~Kelvin.

573. (amended) The method of claim 570, wherein the one or more ~~heat source~~heaters comprise at least two ~~heat source~~heaters, and wherein superposition of heat from at least the two ~~heat source~~heaters pyrolyzes at least some hydrocarbons within the ~~selected section~~part of the formation.

574. (amended) The method of claim 570, wherein controlling the average temperature comprises maintaining a temperature in the ~~selected section~~part of the formation within a pyrolysis temperature range of about 270 °C to about 400 °C.

575. (amended) The method of claim 570, wherein at least one of the one or more ~~heat source~~heaters comprises an electrical heaters.

576. (amended) The method of claim 570, wherein at least one of the one or more ~~heat source~~heaters comprises a surface burners.

577. (amended) The method of claim 570, wherein at least one of the one or more ~~heat source~~heaters comprises a flameless distributed combustors.

578. (amended) The method of claim 570, wherein at least one of the one or more ~~heat source~~heaters comprises a natural distributed combustors.

579. (amended) The method of claim 570, further comprising controlling a temperature within at least a majority of the ~~selected section~~part of the formation, wherein the pressure is controlled as a function of temperature, or the temperature is controlled as a function of pressure.

580. (amended) The method of claim 570, further comprising controlling the heat such that an average heating rate of the ~~selected section~~part of the formation is less than about 1 °C per day ~~during~~ in a pyrolysis temperature range of about 270 °C to about 400 °C.

581. (amended) The method of claim 570, wherein providing heat from the one or more ~~heat source~~heaters to at least the portion of formation comprises:

heating a selected volume (V) of the coal formation from the one or more ~~heat source~~heaters, wherein the formation has an average heat capacity (C_v), and wherein the heating pyrolyzes at least some hydrocarbons within the selected volume of the formation; and

wherein heating energy/day (*Pwr*) provided to the selected volume is equal to or less than ~~*Pwr*, wherein *Pwr* is calculated by the equation:~~

~~$Pwr = h*V*C_v*\rho_B$,~~

~~wherein *Pwr* is the heating energy/day, *h* is an average heating rate of the formation,~~ ρ_B is formation bulk density, and wherein ~~the~~ an average heating rate (*h*) of the selected volume is ~~less than~~ about 10 °C/day.

583. (amended) The method of claim 570, wherein providing heat from the one or more ~~heat source~~heaters comprises heating the ~~selected section~~part of the formation such that a thermal conductivity of at least a portion of the ~~selected section~~part of the formation is greater than about 0.5 W/(m °C).

595. (amended) The method of claim 570, wherein the produced mixture comprises a non-condensable component, wherein the non-condensable component comprises molecular hydrogen, wherein the molecular hydrogen is greater than about 10 % by volume of the non-condensable component, and wherein the molecular hydrogen is less than about 80 % by volume of the non-condensable component at 25 °C and one atmosphere absolute pressure.

602. (amended) The method of claim 570, further comprising:

providing hydrogen (H_2) to the ~~heated section~~part of the formation to hydrogenate hydrocarbons within the ~~section~~part of the formation; and

heating a portion of the ~~section~~ part of the formation with heat from hydrogenation.

604. (amended) The method of claim 570, wherein allowing the heat to transfer comprises increasing a permeability of a majority of the ~~selected section~~part of the formation to greater than about 100 millidarcy.

605. (amended) The method of claim 570, wherein allowing the heat to transfer comprises substantially uniformly increasing a permeability of a majority of the ~~selected section~~part of the formation.

607. (amended) The method of claim 570, wherein producing the mixture comprises producing the mixture in a production well, and wherein at least about 7 ~~heat source~~heaters are disposed in the formation for each production well.

608. (amended) The method of claim 570, further comprising providing heat from three or more ~~heat source~~heaters to at least a portion of the formation, wherein three or more of the ~~heat source~~heaters are located in the formation in a unit of ~~heat source~~heaters, and wherein the unit of ~~heat source~~heaters comprises a triangular pattern.

609. (amended) The method of claim 570, further comprising providing heat from three or more ~~heat source~~heaters to at least a portion of the formation, wherein three or more of the ~~heat source~~heaters are located in the formation in a unit of ~~heat source~~heaters, wherein the unit of ~~heat source~~heaters comprises a triangular pattern, and wherein a plurality of the units are repeated over an area of the formation to form a repetitive pattern of units.

623. (amended) A method of treating a coal formation in situ, comprising:

providing heat from one or more ~~heat source~~heaters to at least a portion of the formation;

allowing the heat to transfer from the one or more ~~heat source~~heaters to a ~~selected section~~part of the formation to raise an average temperature within the ~~selected section~~part of the formation to, or above, a temperature that will pyrolyze hydrocarbons within the ~~selected section~~part of the formation;

producing a mixture from the formation; and

controlling a weight percentage of olefins of the produced mixture to be less than about 20 % by weight by controlling average pressure and average temperature in the ~~selected section~~part of the formation such that the average pressure in the ~~selected section~~part of the formation is greater than the pressure (p) set forth in the following equation for an assessed average temperature (T) in the ~~selected section~~part of the formation:

$$p = e^{[-57000/T + 83]}$$

where p is measured in psia and T is measured in °-Kelvin.

665. (amended) A method of treating a coal formation in situ, comprising:

providing heat from one or more ~~heat source~~heaters to at least a portion of the formation;

allowing the heat to transfer from the one or more ~~heat source~~heaters to a ~~selected section~~part of the formation to raise an average temperature within the ~~selected section~~part of the formation to, or above, a temperature that will pyrolyze hydrocarbons within the ~~selected section~~part of the formation;

producing a mixture from the formation; and

controlling hydrocarbons having carbon numbers greater than 25 of the produced mixture to be less than about 25 % by weight by controlling average pressure and average temperature in the ~~selected section~~part of the formation such that the average pressure in the ~~selected section~~part of the formation is greater than the pressure (p) set forth in the following equation for an assessed average temperature (T) in the ~~selected section~~part of the formation:

$$p = e^{[-14000/T + 25]}$$

where p is measured in psia and T is measured in °-Kelvin.

668. (amended) The method of claim 665, wherein the one or more ~~heat source~~heaters comprise at least two ~~heat source~~heaters, and wherein superposition of heat from at least the two ~~heat source~~heaters pyrolyzes at least some hydrocarbons within the ~~selected section~~part of the formation.

669. (amended) The method of claim 665, wherein at least one of the one or more ~~heat source~~heaters comprises an electrical ~~heaters~~.

670. (amended) The method of claim 665, wherein at least one of the one or more ~~heat source~~heaters comprises a surface burners.

671. (amended) The method of claim 665, wherein at least one of the one or more ~~heat source~~heaters comprises a flameless distributed combustors.

672. (amended) The method of claim 665, wherein at least one of the one or more ~~heat source~~heaters comprises a natural distributed combustors.

673. (amended) The method of claim 665, further comprising controlling a temperature within at least a majority of the ~~selected section~~part of the formation, wherein the pressure is controlled as a function of temperature, or the temperature is controlled as a function of pressure.

674. (amended) The method of claim 673, wherein controlling the temperature comprises maintaining a temperature within the ~~selected section~~part of the formation within a pyrolysis temperature range of about 270 °C to about 400 °C.

675. (amended) The method of claim 665, further comprising controlling the heat such that an average heating rate of the ~~selected section~~part of the formation is less than about 1 °C per day ~~during~~ in a pyrolysis temperature range of about 270 °C to about 400 °C.

676. (amended) The method of claim 665, wherein providing heat from the one or more ~~heat source~~heaters to at least the portion of formation comprises:

heating a selected volume (V) of the coal formation from the one or more ~~heat source~~heaters, wherein the formation has an average heat capacity (C_v), and wherein the heating pyrolyzes at least some hydrocarbons within the selected volume of the formation; and

wherein heating energy/day (Pwr) provided to the selected volume is equal to or less than ~~Pwr, wherein Pwr is calculated by the equation:~~

~~$Pwr = h*V*C_v*\rho_B$,~~

~~wherein Pwr is the heating energy/day, h is an average heating rate of the formation, ρ_B~~ is formation bulk density, and wherein ~~the~~ an average heating rate (h) of the selected volume is ~~less than~~ about 10 °C/day.

678. (amended) The method of claim 665, wherein providing heat from the one or more ~~heat source~~heaters comprises heating the ~~selected section~~part of the formation such that a thermal conductivity of at least a portion of the ~~selected section~~part of the formation is greater than about 0.5 W/(m °C).

690. (amended) The method of claim 665, wherein the produced mixture comprises a non-condensable component, wherein the non-condensable component comprises molecular hydrogen, wherein the molecular hydrogen is greater than about 10 % by volume of the non-condensable component, and wherein the molecular hydrogen is less than about 80 % by volume of the non-condensable component at 25 °C and one atmosphere absolute pressure.

696. (amended) The method of claim 665, further comprising:

providing hydrogen (H_2) to the ~~heated section~~part of the formation to hydrogenate hydrocarbons within the ~~section~~part of the formation; and

heating a portion of the ~~section~~ part of the formation with heat from hydrogenation.

698. (amended) The method of claim 665, wherein allowing the heat to transfer comprises increasing a permeability of a majority of the ~~selected section~~part of the formation to greater than about 100 millidarcy.

699. (amended) The method of claim 665, wherein allowing the heat to transfer comprises substantially uniformly increasing a permeability of a majority of the ~~selected section~~part of the formation.

701. (amended) The method of claim 665, wherein producing the mixture comprises producing the mixture in a production well, and wherein at least about 7 ~~heat source~~heaters are disposed in the formation for each production well.

702. (amended) The method of claim 665, further comprising providing heat from three or more ~~heat source~~heaters to at least a portion of the formation, wherein three or more of the ~~heat~~

~~source~~heaters are located in the formation in a unit of ~~heat source~~heaters, and wherein the unit of ~~heat source~~heaters comprises a triangular pattern.

703. (amended) The method of claim 665, further comprising providing heat from three or more ~~heat source~~heaters to at least a portion of the formation, wherein three or more of the ~~heat source~~heaters are located in the formation in a unit of ~~heat source~~heaters, wherein the unit of ~~heat source~~heaters comprises a triangular pattern, and wherein a plurality of the units are repeated over an area of the formation to form a repetitive pattern of units.

704. (amended) A method of treating a coal formation in situ, comprising:

providing heat from one or more ~~heat source~~heaters to at least a portion of the formation;

allowing the heat to transfer from the one or more ~~heat source~~heaters to a ~~selected section~~part of the formation to raise an average temperature within the ~~selected section~~part of the formation to, or above, a temperature that will pyrolyze hydrocarbons within the ~~selected section~~part of the formation;

producing a mixture from the formation; and

controlling an atomic hydrogen to carbon ratio of the produced mixture to be greater than about 1.7 by controlling average pressure and average temperature in the ~~selected section~~part of the formation such that the average pressure in the ~~selected section~~part of the formation is greater than the pressure (p) set forth in the following equation for an assessed average temperature (T) in the ~~selected section~~part of the formation:

$$p = e^{[-38000/T + 61]}$$

where p is measured in psia and T is measured in ~~°~~Kelvin.